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US 4900072 A US 3652110 A

(58) Field of search
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INT CL[5] F16L 23/032 47/00 47/06 58/18

(54) Coupling flange for one or more aluminum refrigerant pipes

(57) Aluminum pipes (63, 65) are joined to other pipes, not shown, by a pair of coupling flanges. Each flange (121, 123) is made of nonconductive plastics material in order to prevent corrosion of the pipes (63, 65) and heat transfer between the pipes. Screws (143, 145) are used to clamp two flange sections (121, 123) around the pipes (63, 65) in order to form one of the flanges. The screws (143, 145) are insulated from the pipes (63, 65) by the plastics material and therefore corrosion does not occur.

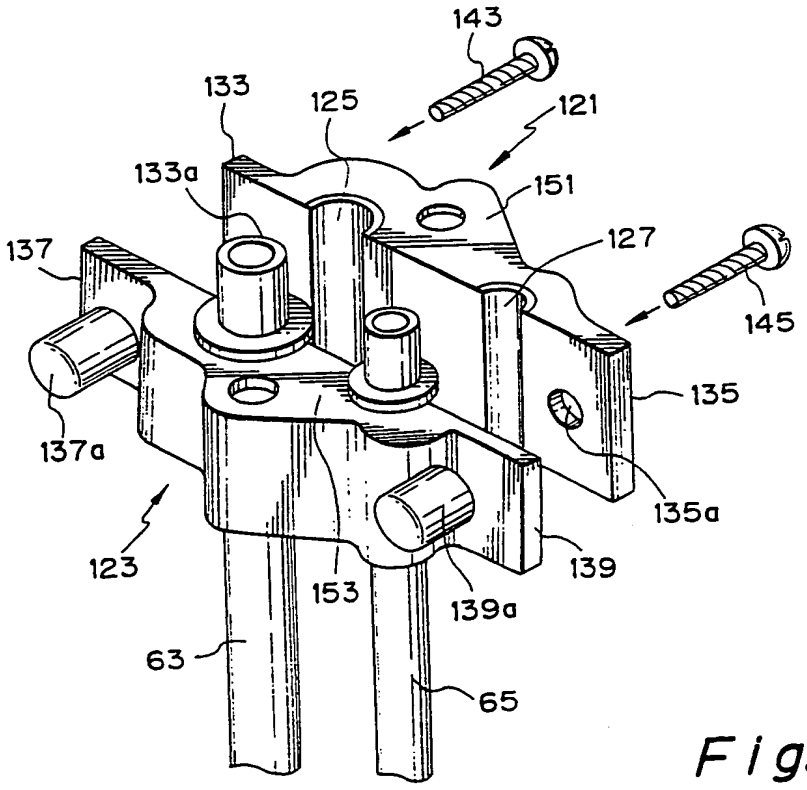


Fig. 12

GB 2 253 667 A

Fig. 1

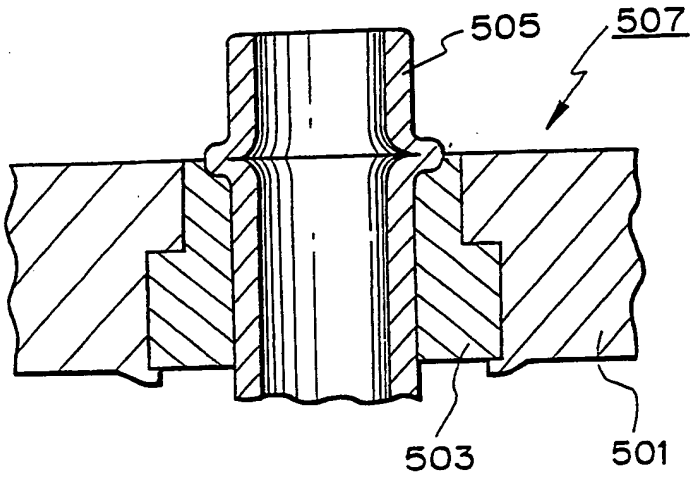


Fig. 2-(a)

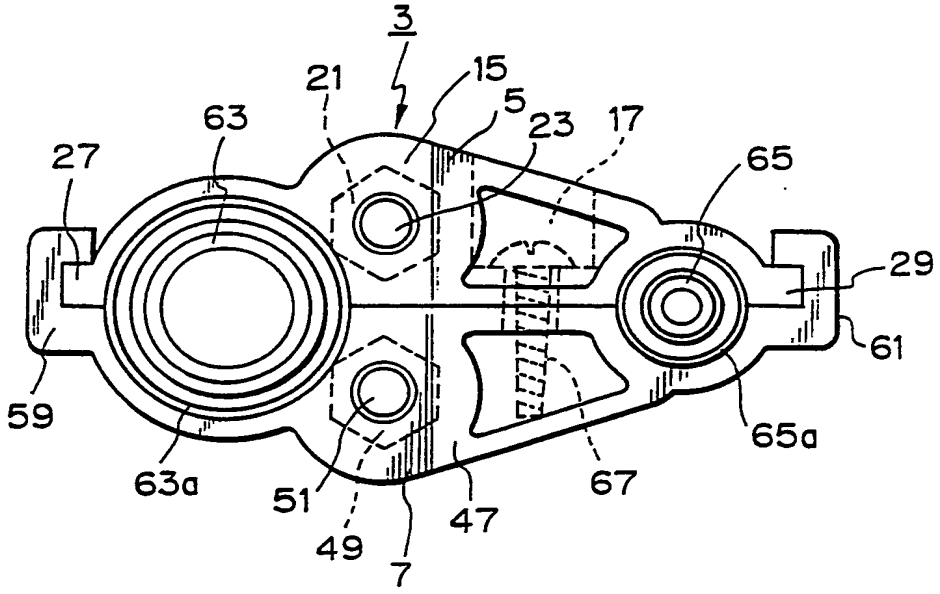

3
21
15
5
23
17
63
27
65
29
61
59
65a
63a
51
49
47
67
7

Fig. 2-(b)

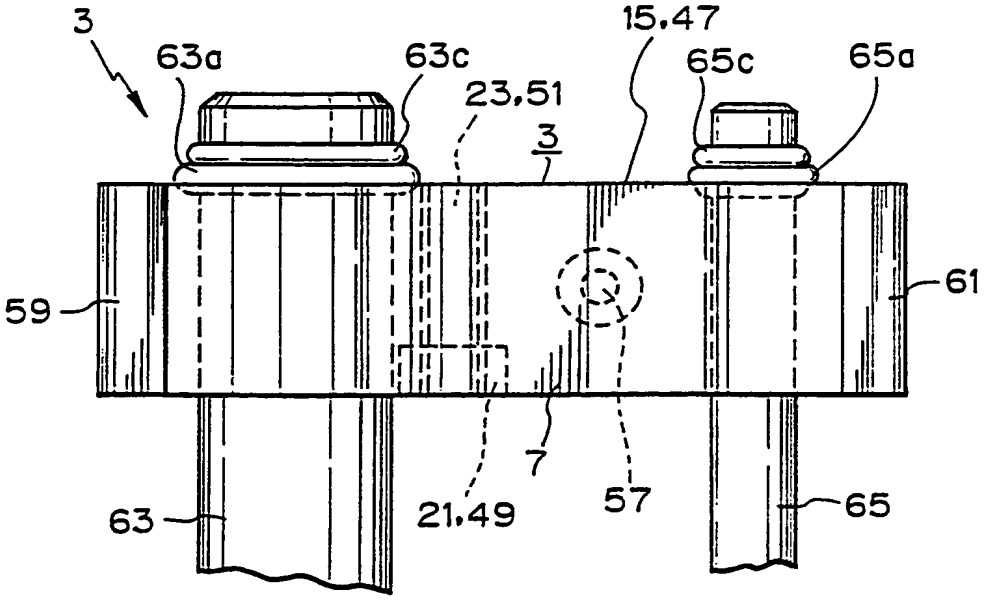

3
63a
63c
15.47
65c
65a
23,51
3
59
61
7
63
21,49
57
65

Fig. 3-(a)

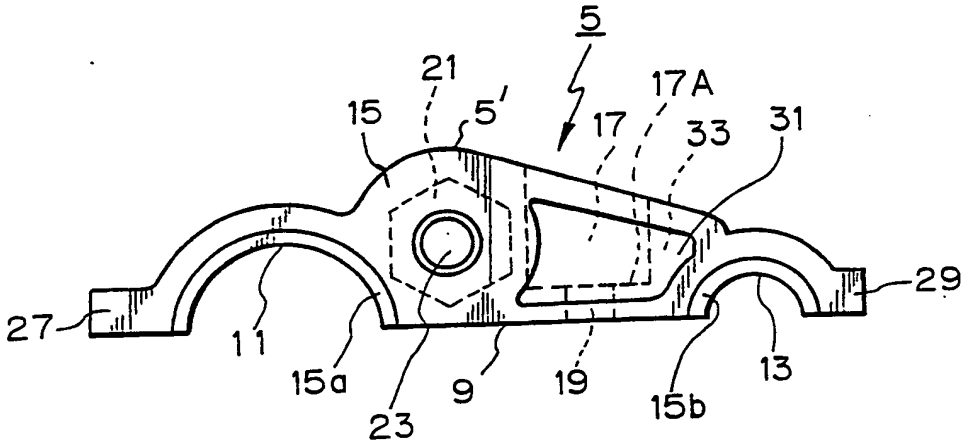

5
21
5'
15
17A
17
33
31
29
27
11
15a
23
9
19
15b
13

Fig. 3-(b)

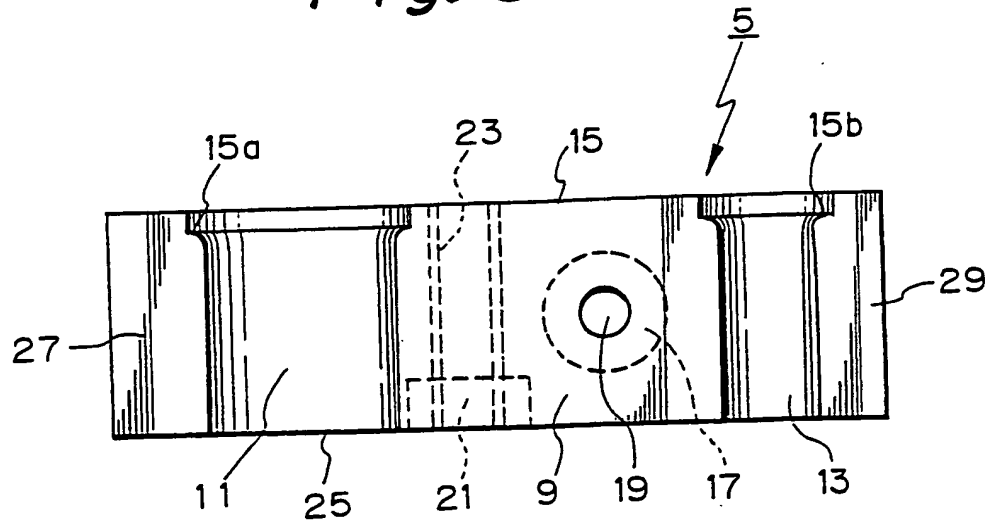

5
15a
23
15
15b
29
27
11
25
21
9
19
17
13

Fig. 4-(a)

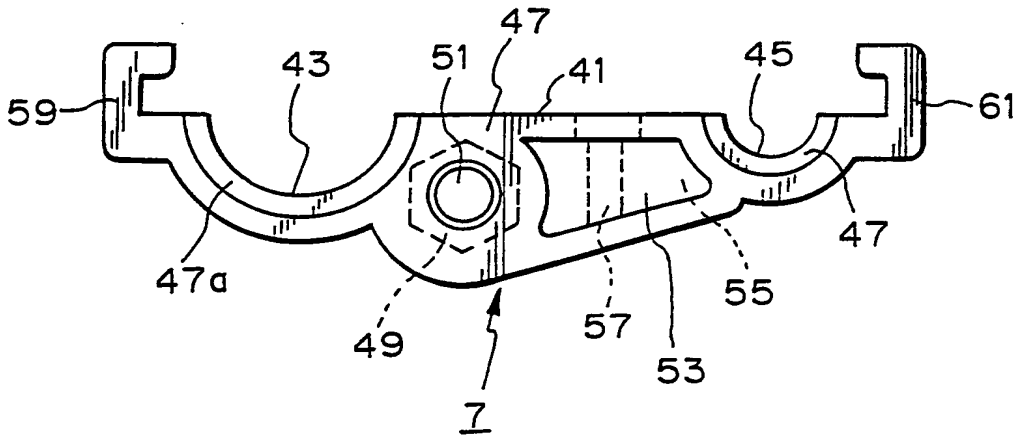

47
43
51
41
45
59
61
47
47a
55
49
57
53
7

Fig. 4-(b)

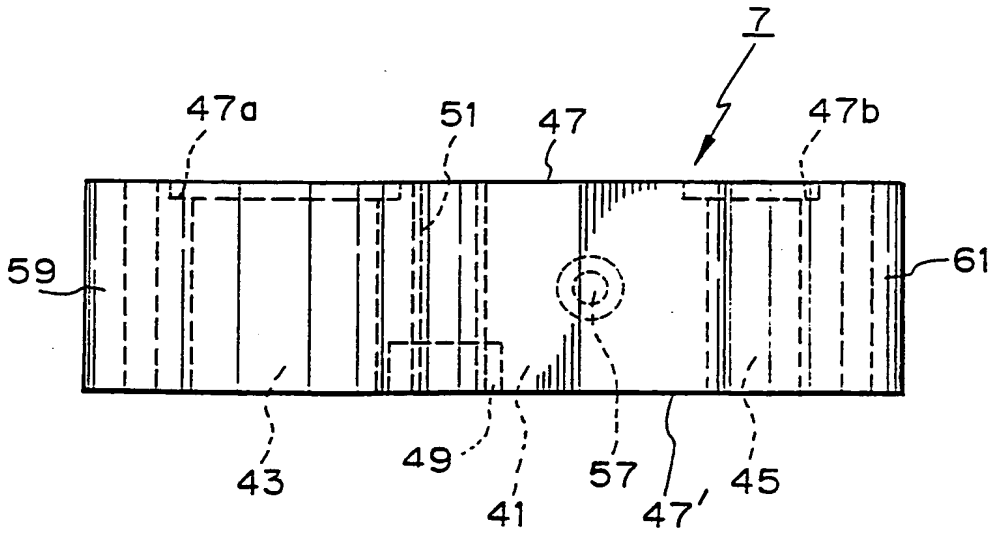

7
47a
51
47
47b
59
61
43
49
57
45
41
47'

Fig. 5

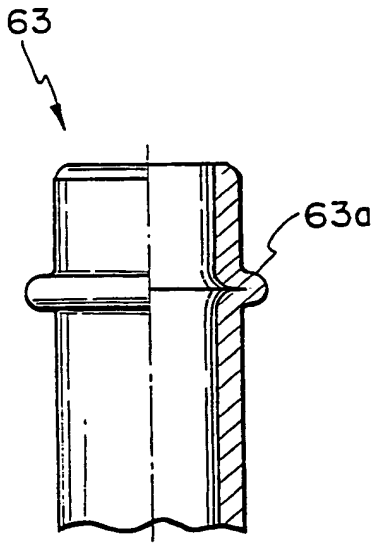


Fig. 6

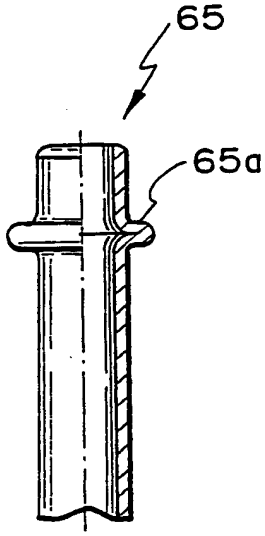


Fig. 7

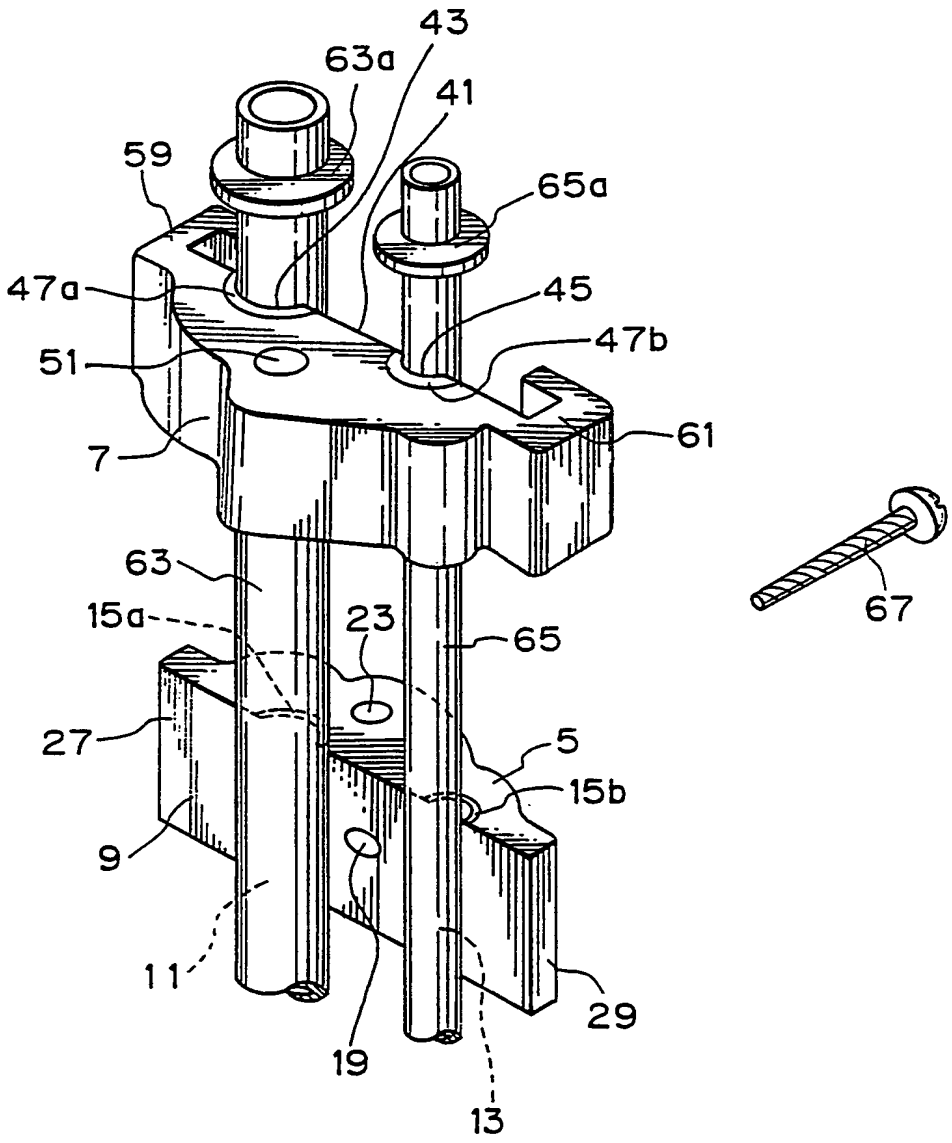

43
63a
41
59
65a
47a
45
47b
51
61
7
63
15a
23
65
67
27
5
15b
9
11
29
19
13

Fig. 8

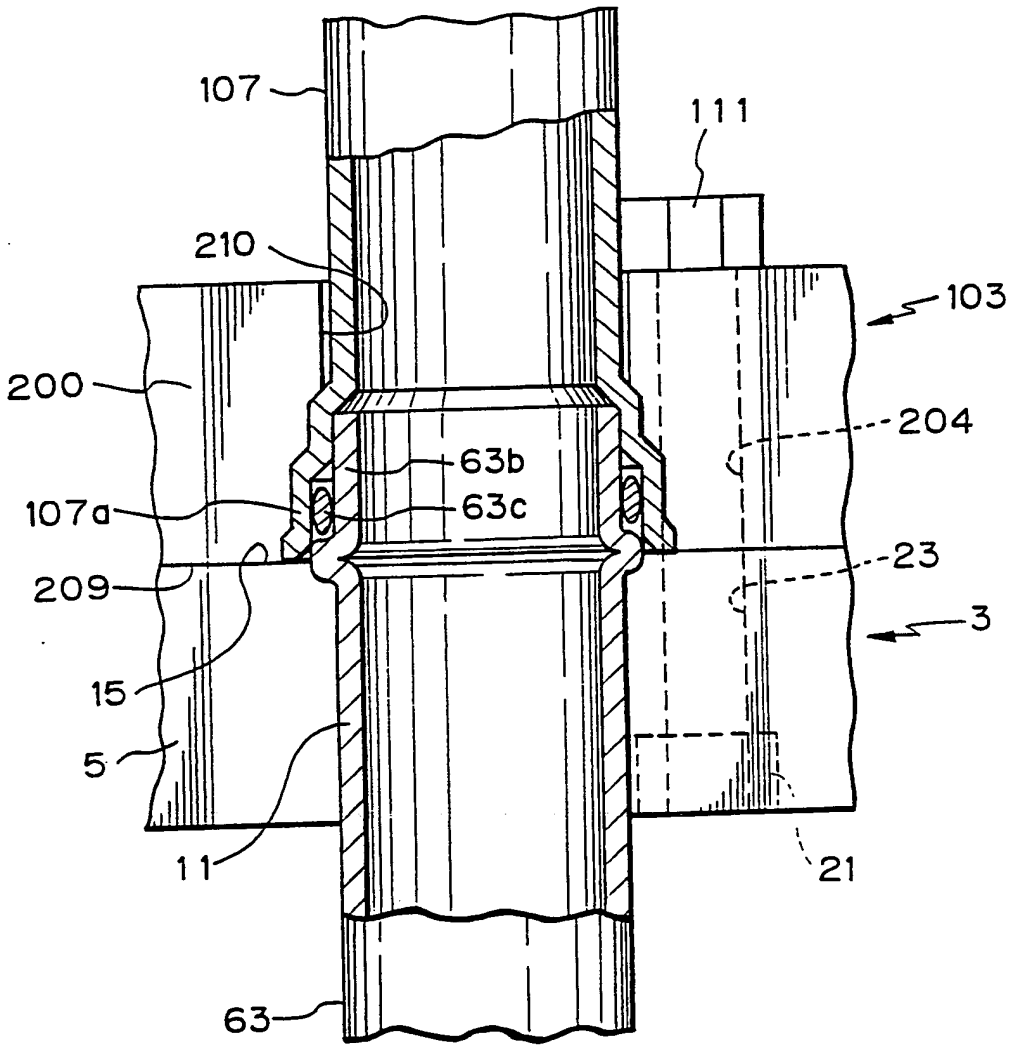


Fig. 9-(a)

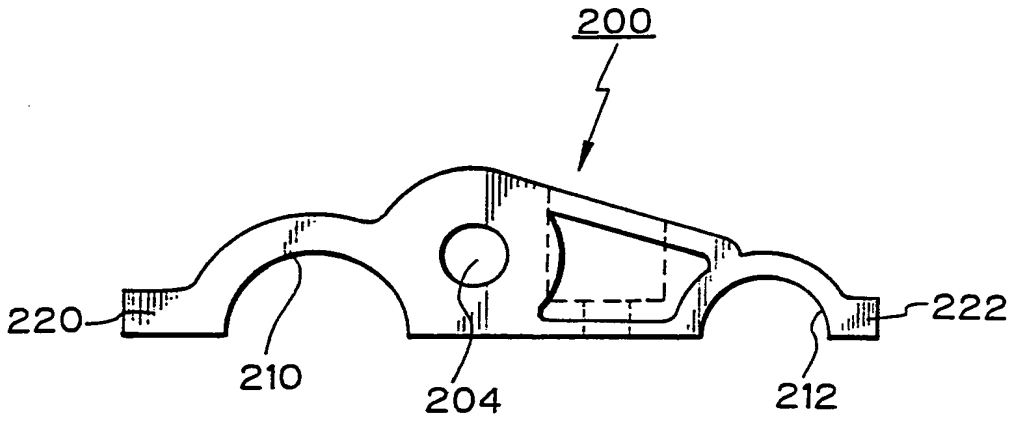


Fig. 9-(b)

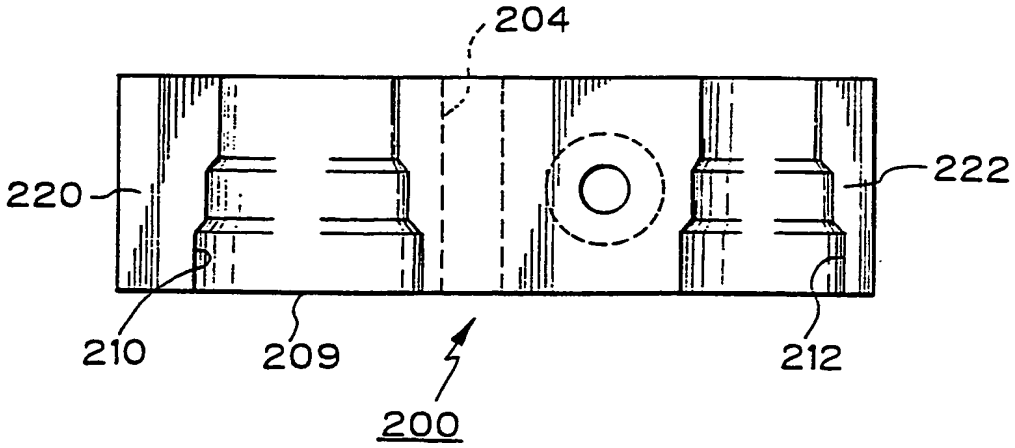


Fig. 10-(a)

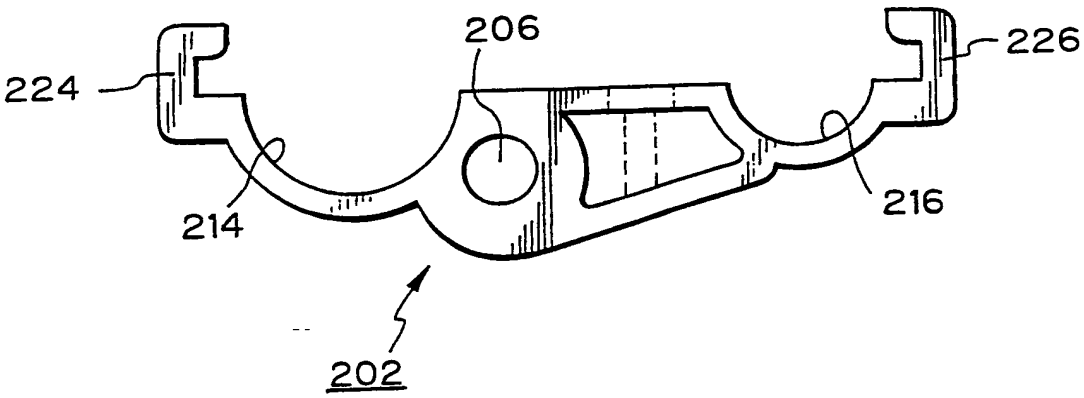
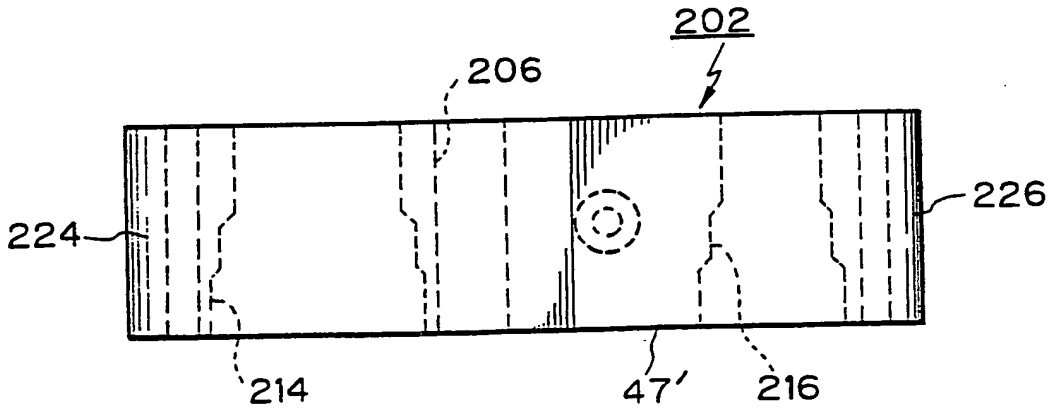


Fig. 10-(b)



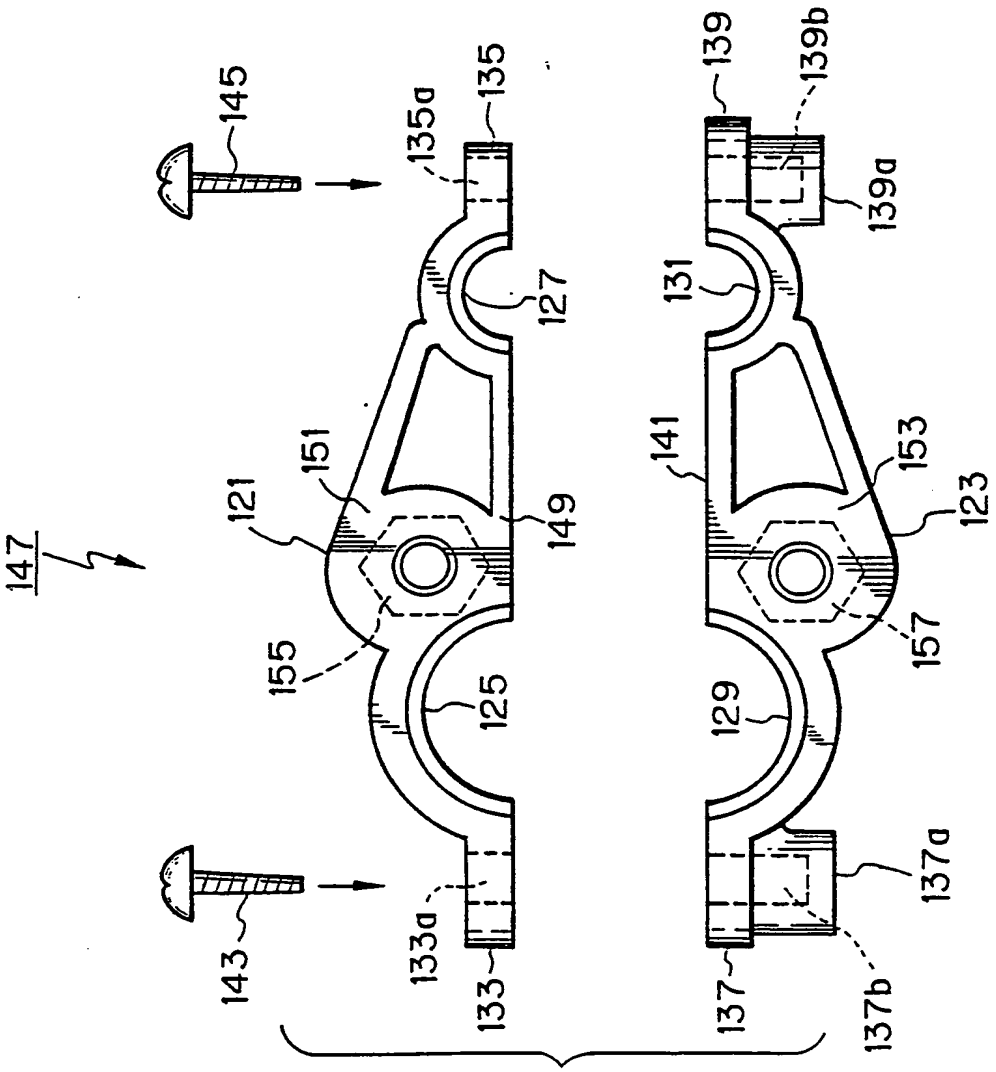
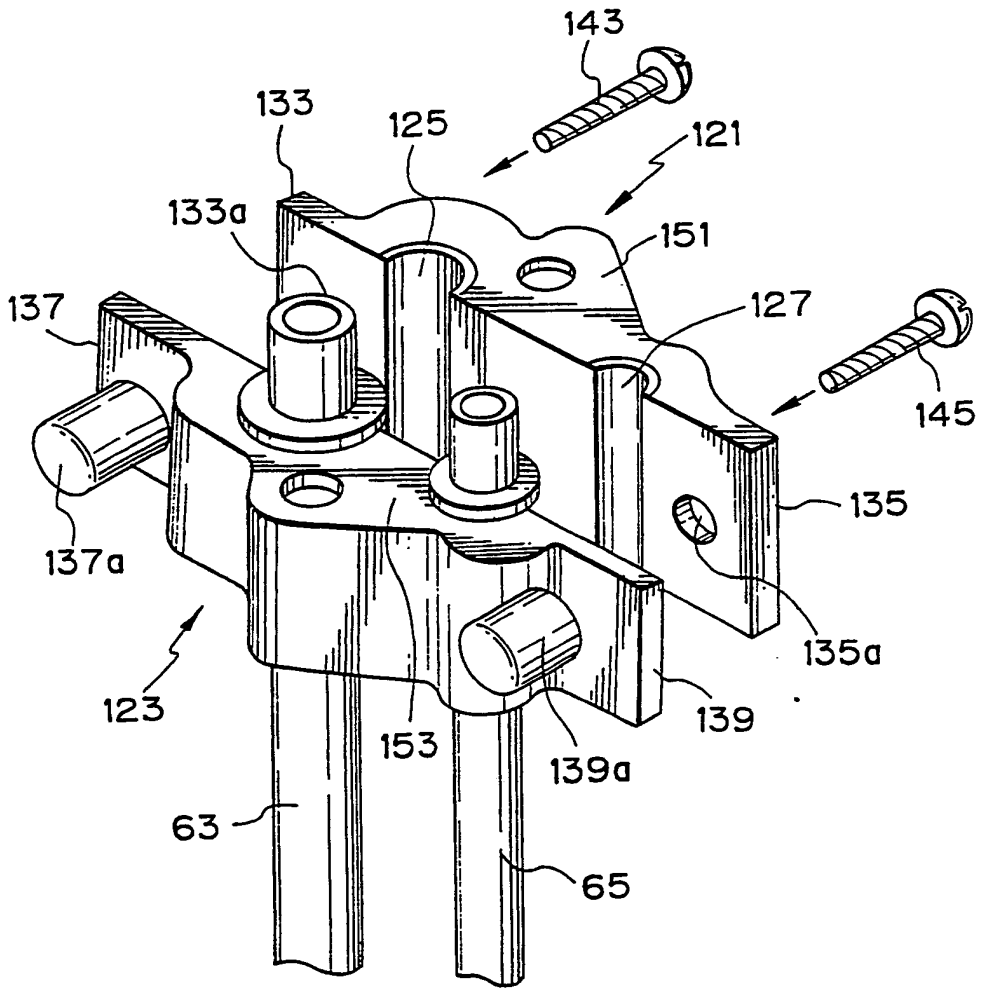

147
145
143
135
135a
133
133a
127
125
121
151
149
155
139
139b
139a
131
141
153
123
157
129
137
137a
137b

Fig. 11

Fig. 12


143
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125
121
133a
151
137
127
145
135
137a
135a
123
153
139
139a
63
65

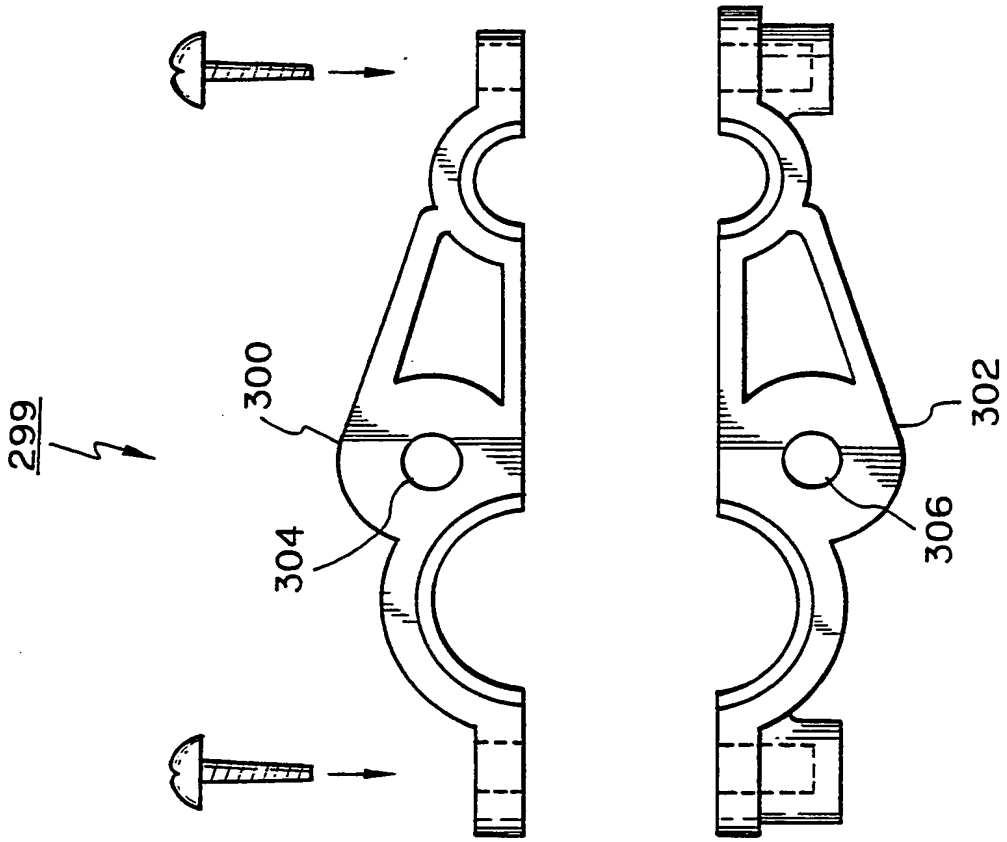


Fig. 13

Fig. 14

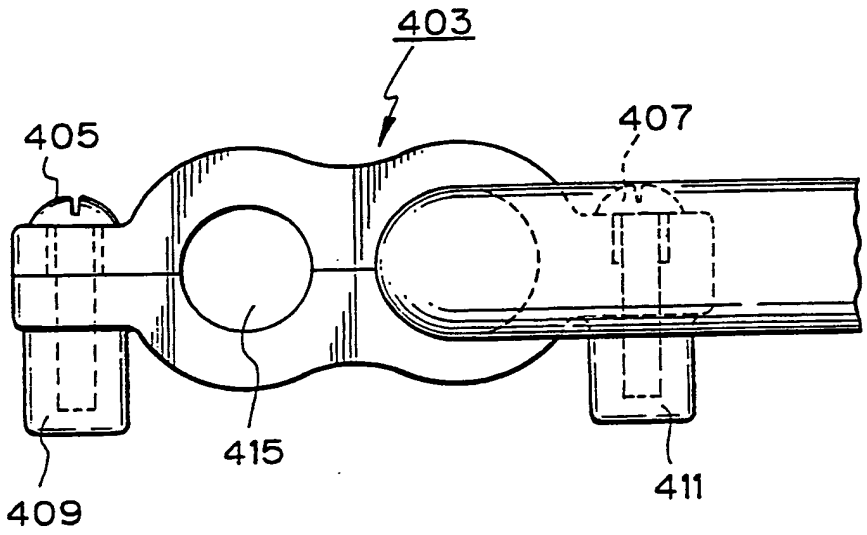


Fig. 15

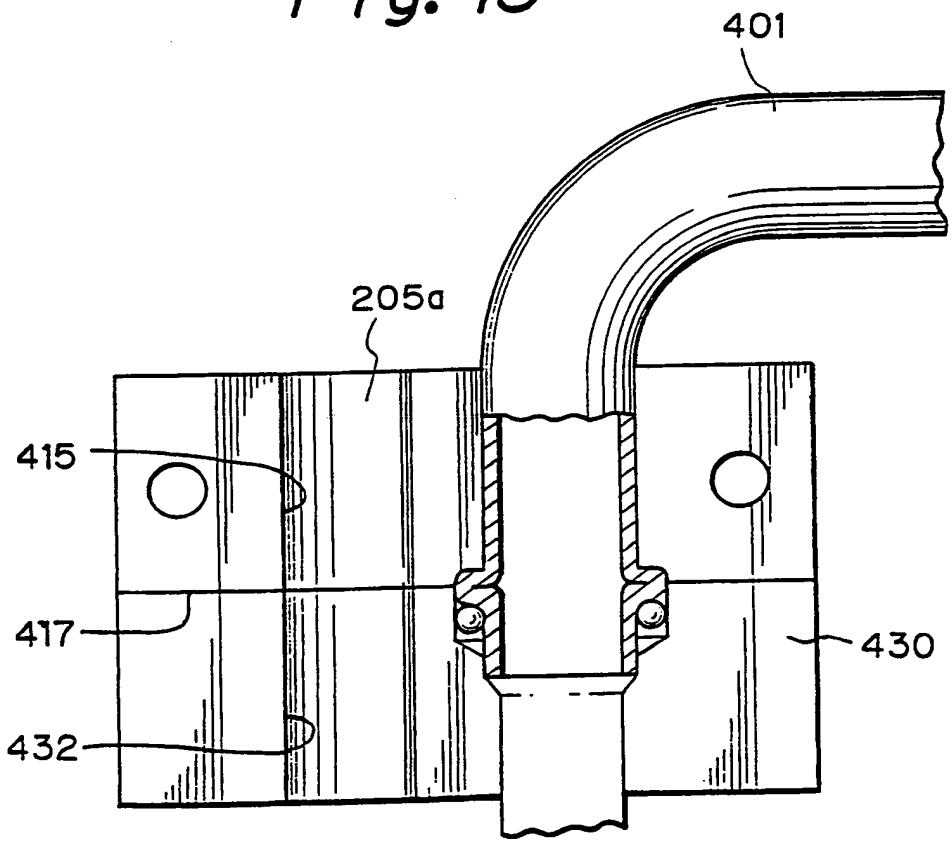
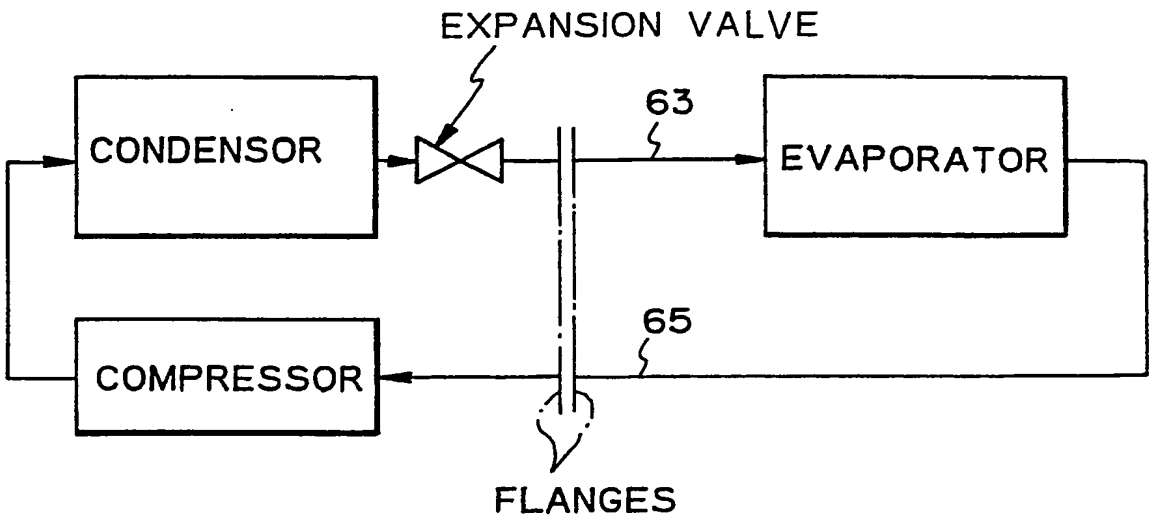


Fig. 16


EXPANSION VALVE
CONDENSOR
63
EVAPORATOR
65
COMPRESSOR
FLANGES

COUPLING FLANGE FOR ONE OR MORE ALUMINUM REFRIGERANT PIPES

The present invention relates to a coupling flange for one or more aluminum refrigerant pipes, such as aluminum pipes in an air conditioning apparatus for an automobile.

Throughout the specification the term aluminum includes not only pure aluminum but also any alloy based on aluminum, except where otherwise defined.

Current requirements for a reduction of the weight of an automobile, as much as possible, have led to a requirement for a similar reduction of the weight of an air conditioning apparatus used in the automobile. To reduce the weight of an air conditioning apparatus, pipe couplings used in the air conditioning apparatus must have as low a weight as possible, and to obtain such a light weight pipe coupling a coupling has been proposed that comprises a pair of flanges made of aluminum and mounted at the ends of pipes to be connected. These flange members mounted at the ends of the pipes are connected to each other to thereby connect the pipes. (See Japanese Unexamined Patent Publication No. 60-43416).

Nevertheless, in view of the high pressure of the refrigerant flowing through the pipes, the strength of the pipe couplings constructed by the flanges made of aluminum is too low unless the flange is provided with a large outer diameter, but a flange having such a large outer diameter is not desirable from the viewpoint of an efficient utilization of space.

Therefore, it has been proposed to use an inner flange made of a steel material and arranged between a pipe and an outer flange both made of aluminum. Such a construction, however, allows contact between different materials, i.e. aluminum and steel, and this generates an electromotive force between the flange made of steel and the pipe made of aluminum, and accordingly a more rapid corrosion of the metal parts. Depending on the components of the steel used for the flange, corrosion of the pipes may occur, and thus the refrigerant under a high pressure may be leaked to the outside.

According to the present invention, there is provided a coupling flange for one or more aluminum refrigerant pipes, the flange having one or more apertures for receiving the pipe(s) and an abutment surface for abutting against a similar surface to form a coupling, the coupling flange being made of nonconductive plastics material at least where it is, in use, in contact with the pipe(s).

In embodiments, because each pipe is only in contact with electrically nonconductive plastics material of the flange, corrosion of the pipe is prevented. If the plastics material is also thermally nonconductive, heat transfer to or from the pipe is also minimized.

The invention will now be described by way of non-limiting embodiments with reference to the accompanying drawings, in which:-

Fig. 1 shows a flange of the prior art;

Fig. 2-(a) is a top elevational view of a flange with pipes, according to the present invention;

Fig. 2-(b) is a side elevational view of the flange shown in Fig. 2-(a);

Fig. 3-(a) is a top elevational view of a first flange section of the flange of Fig. 2;

Fig. 3-(b) is a side elevational view of the first flange section shown in Fig. 3-(a);

Fig. 4-(a) is a top elevational view of a second flange section shown in the flange of Fig. 2;

Fig. 4-(b) is a side elevational view of the second flange section shown in Fig. 4-(a);

Figs. 5 and 6 are cross sectional views of pipes shown in Fig. 2;

Fig. 7 is a perspective view of the flange shown in Fig. 2 when assembled to the pipes;

Fig. 8 is a partial cross sectional view of the flange and pipe shown in Fig. 2, when connected to another pipe with a flange;

Fig. 9-(a) is a top elevational view of a first flange section of a flange used with the upper pipe shown in Fig. 8;

Fig. 9-(b) is a side elevational view of the first flange section shown in Fig. 9-(a);

Fig. 10-(a) is a top elevational view of a second flange section of a flange used with the upper pipe shown in Fig. 8;

Fig. 10-(b) is a side elevational view of the second flange section shown in Fig. 10-(a);

Fig. 11 is a top plan view of a second embodiment of the flange according to the present invention;

Fig. 12 is perspective view of the flange shown in Fig. 11, when assembled to the pipes;

Fig. 13 is a top plan view of complementary flange for use with the flange of Fig. 11;

Fig. 14 is a top plan view of a third embodiment of the flange according to the present invention, when used for a single refrigerant pipe;

Fig. 15 is a side plan view of the flange shown in Fig. 14; and,

Fig. 16 illustrates an arrangement of the pipes coupled with flanges according to the present invention, in a refrigerant line for a refrigerating cycle in an air conditioning apparatus for an automobile.

Figure 1 illustrates a prior art coupling flange. In the prior art construction, an outer flange 501 made of aluminum is connected to an aluminum pipe 505 via an inner sleeve 503 made of steel. This aluminum-steel flange construction is used to obtain a desired strength while preventing an increase in weight. Nevertheless, contact between different metal materials inevitably occurs, resulting in the generation of an electromotive force, and accordingly a rapid corrosion thereof.

In Figs. 2-(a) and 2-(b), showing a first embodiment of the present invention, a flange 3 is connected to the top ends of pipes 63 and 65 for carrying a refrigerant. The flange 3 is made of aluminum and comprises separate flange sections 5 and 6. Figure 3-(a) and 3-(b) are top plan and side elevational views, respectively, of the first flange section 5, and Figs. 4-(a) and 4-(b) are a top plan and side elevational views, respectively, of the second flange section 7. These sections 5 and 7 are formed by an injection moulding process of a non-conductive resin material, preferably having a high strength and selected from resin materials such as nylon, polyprophylene, polyoximethylene, epoxy, or polyester. Among these materials, a resin of nylon 66 is most preferable.

As shown in Figs. 3-(a) and 3-(b), the first flange section 5 has a surface 9 separating same from the second flange section 7, the plane of the surface 9 extending parallel to the axes of the pipes 63 and 65, and upper and lower end surfaces 15 and 25 extending at a right angle to the axes of the pipes 63 and 65. The upper surface 15 allows a connection of the flange section 5 to an adjacent flange. The first flange section 5 has grooves 11 and 13 having a semi-circular cross section and extending vertically throughout the height of the section 5, so that the grooves 11, 13 open at the upper

and lower end surfaces 15 and 25. The groove 11 and the second groove 13 have different diameters to each other, for receiving the pipes 63 and 65, respectively, each having a different diameter. The grooves 11 and 13 define, at respective upper ends thereof open at the top surface 15 for connection to an adjacent flange, annular stepped portions 15a and 15b for receiving bulged portions 63a and 65a of the pipes 63 and 65, respectively, as shown in Fig. 3-(b).

As shown in Fig. 3-(a), in the side opposite the surface 9, a depression 17 having a cylindrical shape and a bottom end 17A is formed so that it extends at a right angle to the surface 9, between the first and the second grooves 11 and 13 of the section 5. A bore 19, coaxial to the cylindrical groove 17, is also formed in the section 5. The bore 19 has a first end open to the bottom end 17A of the cylindrical depression 17 and a second end open to the division surface 9, and a nut 21 made of a metal material is located in the section 5 at a position between the first groove 11 and the cylindrical recess 17, and flush with the bottom plane 25. An insert moulding process is carried out whereby the nut 21 is set at a predetermined location in a mould when the plastic material is injected to the mould to obtain the flange section 5. The flange section 5 has a screw bore 23 extending coaxially from the nut 21 to the top surface 15, and the screw bore 23 has the same diameter as that of a screw bore of the nut 21. The first flange section 5 is provided on the same plane as the surface 9 with a pair of oppositely projecting portions 27 and 29. Furthermore, reference numerals 31 and 33 denote cut out portions of the connection surface 15 and the opposite surface 25, which do not adversely affect the operation of the connection device but reduce the total weight of the flange section 5.

The second flange section 7, as shown in Figs. 4-(a) and 4-(b), has a surface 41 separating same from the

first flange section 5, the plane of the surface 41 extending parallel to the axes of pipes 63 and 65, and upper and lower end surfaces 47 and 47'. The upper surface 47 allows a connection of the flange section 7 to an adjacent flange. The second flange section 7 has grooves 47 and 45 having a semicircular cross section and extending vertically throughout the height of the section 7, so that the grooves 43 and 45 are open to the upper and lower end surfaces 47 and 47'. The groove 43 and the second groove 45 have different diameters to each other, for receiving the pipes 63 and 65, respectively, each having a different diameter. The grooves 43 and 45 define, at respective upper ends thereof open to the top wall 47, annular stepped recessed portions 47a and 47b.

As shown in Fig. 4-(a), from the surface, a screwed bore 57 is formed so that it extends at a right angle to the surface 41 between the first and the second grooves 43 and 45 of the section 7. A nut 49 made of a metal material is located in the section 7 at a position between the first groove 43 and the second groove 45, and flush with the bottom plane 47'. An insert moulding process is carried out whereby the nut 49 is set at a predetermined location in a mould when the plastic material is injected to the mould to obtain the second flange section 7. The second flange section 7 has a screw bore 51 extending coaxially from the nut 49, and the screw bore 51 has the same diameter as that of a screw bore of the nut 49. The second flange section 7 is provided in the same plane as the surface 41 with a pair of opposite guide or hook portions 59 and 61. Furthermore, as with the first flange section 5, cut out portions 53 and 55 are provided in the top surface 47 and the bottom surface 47', to reduce the total weight of the flange section 7.

The structural difference between the second flange section 7 and the first flange section 5 is that, in place of the cylindrical depression 17 in the first

section 5, the screw bore 57 is formed in the second section 7, and in place of the projected portions 27 and 29 of the first section 5, the guide or hook portions 59 and 61 are provided on the second section 7.

As will be easily seen from the above explanation, the nuts 21 and 49 are completely buried in the block of resin, and the grooves 11 and 13 in the first section 5 and the grooves 43 and 45 in the second section 7, in which the aluminum pipes 63 and 65 are held, are separated from each other by the respective inside surfaces of the resin flange sections 5 and 7.

Figure 5 shows a pipe 63 made of aluminum and used for carrying a refrigerant in an air conditioning apparatus for an automobile. One end of the pipe 63 is provided with an annular bulged portion 63a on the outer wall thereof, with which the flanges according to the present invention are engaged as fully described later. Figure 6 show another pipe 65 made of aluminum and used for carrying a refrigerant in the air conditioning apparatus. The diameter of the second pipe 65 is smaller than that of the first pipe 63, but similar to the pipe 63, the pipe 65 is provided with an annular bulged portion 65a on the outer wall thereof.

A connection of the divided flange 3 according to the present invention with respect to the aluminum pipes 63 and 65 shown in Figs. 5 and 6 will be explained. As shown in Fig. 7, the first flange section 5 is fitted to the pipes 63 and 65 in such a manner that the semicircular grooves 11 and 13 are engaged with the outer surfaces of the pipes 63 and 65, respectively. The second flange section 7 is located so as to face the first flange section 5, and is fitted to the pipes 63 and 65 in such a manner that the semicircular grooves 43 and 45 are engaged with the outer surfaces of the pipes 63 and 65, respectively. The first and the second flange sections 5 and 7 are then moved toward each other in such a manner that the projecting

portions 27 and 29 are engaged with the guide or hook portions 59 and 61, respectively, whereby a combined flange 3 is obtained. The combined sections 5 and 7 are then moved upward to a location at which the flange 3 is engaged with the bulged portion 63a at the stepped portions 15a and 47a of the first and second sections 5 and 7, respectively, and the bulged portion 65a is engaged with the stepped portions 15b and 47b of the first and second sections 5 and 7, respectively. Then, a screw 67 is inserted in the cylindrical depression 17 and the bore 19 of the first section 5, and is screwed into the screw bore 57 of the second section 7. A tightening of the screw 67 brings together the surfaces 9 and 41 of the sections 5 and 7, and the semicircular grooves 11 and 13 and 43 and 45 are firmly engaged with the outer surfaces of the pipes 63, and 65, respectively, to thereby obtain a secure connection between the flange 3 and the pipes 63 and 65 as shown in Figs. 2-(a) and 2-(b). Note, the screw 67 cannot come into contact with the pipes 63 and 65, and thus a metal contact between different kinds of metal materials is prevented.

Figure 8 illustrates the construction of a coupling for connecting pipes by using the present invention. The upper end of the pipe 63 is provided with the flange 3 having the construction as shown in Figs. 3 and 4, and one end of a pipe 107 to be connected to the pipe 63 is provided with a flange 103 comprising a pair of divided flange sections 200 (Figs. 9-(a) and 9-(b)) and 202 (Figs. 10-(a) and 10-(b)) having substantially the same construction as that of the flange sections 5 and 7, respectively, of the flange 3. The flange sections 200 and 202 differ, however, from the sections 5 and 7 1 in that the flange sections 200 and 202, as shown in Figs. 9-(a) and 9-(b) and 10-(a) and 10-(b), respectively, are not provided with the nuts 21 and 49 as in the first flange

3, but only with bores 204 and 206. The second difference lies in the configuration of the semicircular grooves 210 and 212 of the first section 200 and the semicircular grooves 214 and 216 of the second section 202. The semi-circular grooves 210 and 210, and 214 and 216 have, as shown in Figs. 9-(b) and 10-(b), a downwardly widened stepped shape, which allows a bottom end 107a of the pipe 107 (Fig. 8) having a stepped cross sectional shape to be neatly fitted therein.

The thus-constructed first flange section 200 and second flange section 202 are fitted to bottom end of the pipe 107, and the first and second sections 200 and 202 are engaged with each other by projections 220 and 222 and guides 224 and 226, as with the projections 27 and 29 and the guides 59 and 61 explained with reference to Fig. 7. The first and second sections 200 and 202 are then connected to each other by a nut, which is similar to the nut 67 in Fig. 7, whereby the second flange 103 is securely connected to the pipe 107.

A connection of the pipes 63 and 107 by the lower and upper flanges 3 and 103 will be explained. As shown in Fig. 8, the first flange 3 constructed by the flange sections 5 and 7 with the pipes 63 and 65, and the second flange 103 constructed by the flange sections 200 and 202 with the pipe 107 and a not shown pipe are brought together at the top surface 15 and the bottom surface 209 thereof, respectively, so that the upper end of the pipe 63 is inserted in the bottom widened bore 210 of the pipe 107, whereby the first flange 3 fixed to the pipe 63 is brought into end to end contact with the second flange 103 fixed to the pipe 107. An O-ring 63c is arranged in an annular space formed between the pipes 63 and 107. Bolts 111 are then inserted to the bores 204 and 206, respectively, of the upper flange 103, and are screwed, via the respective bores 23 and 51, into the nuts 21 and 49, respectively, of the lower flange 3, and

as a result, an air tight connection is obtained between the upper end of the pipe 63 and the bottom end 107a of the pipe 107 via the O-ring 63c. In the same way, the pipe 65 (Fig. 7), to which the first flange 3 is connected, is connected to a not shown pipe to which the second flange 103 is connected.

The flanges 3 and 103 made of a resin material prevent any contact between different kinds of metal materials, even though the pipes 63, 65 and 107 are made of aluminum, and as a result corrosion of the pipes 63, 65 and 108 is prevented. Note, the bolts 111 cannot come into contact with the pipes 63, 65, and 107.

Figure 11 illustrates a flange 147 as a second embodiment of the present invention and comprises flange sections 121 and 123. This embodiment is different from the first embodiment in that, in place of the cylindrical depression 17, bore 19 and screw bore 57 in the first embodiment, the ends of the sections 121 and 123 are provided with connection parts 133, 135, 137, and 139, i.e. the guide or hook portions 59 and 61 of the first embodiment are omitted. Note, the guide portions 59 and 61 can be provided if they do not adversely affect the screw-fitting operation described later. The connection portions 133 and 135 of the flange section 121 are provided with bores 133a and 135a, respectively, for receiving screws, and the connection portions 137 and 139 of the section 123 are provided with portions 137a and 139a projecting at a right angle to the surface 141. Screw bores 137b and 139b extend from the surface 141 to the surface 149 within the projecting portions 137a and 139b, respectively.

When the flange shown in Fig. 11 is connected to the pipes 63 and 65, the flange sections 121 and 123, as shown in Fig. 12, face each other via the pipes 63 and 65, so that the semi-circular recesses 125 and 129 are fitted to the pipe 63 and the semi-circular recesses 127

and 131 are fitted to the pipe 65. Screws 143 and 145 are introduced into bores 133a and 135a, respectively, of the first flange section 121, and are screwed into the screw bores 137b and 139b, respectively, of the second flange section 123. The screws 143 and 145 are then tightened down to connect the first and second flange sections 121 and 123 to each other while sandwiching the pipes 63 and 65 between the sections 121 and 123, to thus obtain an assembled flange 147. In this assembled state, there is no metal contact between the screws 143 and 145 and the pipes 63 and 65 for carrying the refrigerant.

In the embodiment shown in Figs. 11 and 12, the surfaces 141 and 149 of the flange sections 121 and 123 are in close contact with each other, and the flange sections 121 and 123 are firmly connected to the pipes 63 and 65 at the pairs of semicircular recesses 125 and 129, and 127 and 131. Figure 13 shows a second flange 299 for connecting to the pipes 63 and 65, respectively. The second flange assembly 299 comprises first and second flange sections 300 and 302 has the same construction except that the first and second sections 300 and 302 have only the bores 304 and 306 for an introduction of bolts therethrough. To connect the pipes 63 and 65 held by the first flange 147 to not shown pipes held by the second flange 299, bolts are introduced into the bores 304 and 306 in the second flange 299, and are screwed into nuts 155 and 157 (Fig. 11) in the first and second sections 121 and 123 of the first flange 147, and as a result an interconnection of the respective pipes is obtained by the use of the flanges 147 and 299.

The flange 147 is also formed from a non-conductive resin material, and as a result any contact between different kinds of metals is prevented, and accordingly the pipes 63 and 65 for carrying a refrigerant are not

subjected to corrosion.

The above embodiments are directed to a flange capable of connecting more than one pipe made of aluminum, but the flange 403 in Fig. 14 can be used to connect only one aluminum pipe 401. In this embodiment, the screws 405 and 407 are tightened to connected respective projected portions 409 and 411, to thus grip the pipe for carrying a refrigerant. The flange 403 is provided with a bore 415, and a connecting surface 417 in contact with an adjacent flange 430 to which it is to be connected, in face to face contact. A bolt is inserted in the bore 415 and is screwed into a screw bore 432, whereby the pipes are connected to each other.

In the above embodiments, each of the flanges 3, 103, 147 and 403 is divided into two sections, but the flanges can be made as one body, by moulding. In this case, before the respective bulged portions 63a and 65a in Figs. 5 and 6, respectively, are formed, the pipes are inserted in the respective flanges, and the bulged portions are then formed in the pipes, to be engaged with the respective flanges.

The following table shows examples of the resin materials used for forming the flanges according to the present invention, which resins can provide a desired strength and lower weight while preventing corrosion.

No. Resin	Filler (wt%)	Tensile Strength (kg/mm^2)	Bending Strength (kg/mm^2)	Bending Modulus (kg/mm^2)	Thermal Expansion Factor ($x10^{-5}/°C$)
1 poly-propylene	30	4.8	5.3	280	3.9
2 poly-oxi-methylen	25	9.0	19.7*	430	3.0
3 nylon 66	30	10.6	16.0	500	3.0

* Measured at 23°C. Others are measured at 80°C.

The use of a resin material such as an epoxy resin and polyester resin for the flange provides the following advantages. The pipes connected by these flanges are used in a refrigerating cycle at a location near an expansion valve, as shown in Fig. 16, in such a manner that the pipe 63 is located between an expansion valve and an evaporator and the pipe 65 is located between the evaporator and a compressor. Namely, in the pipe 63, a refrigerant flowing at a temperature of as low as 2°C flows from the expansion valve in a mist state, and in the pipe 65 the refrigerant flowing from the evaporator to the compressor has a temperature as high as 80°C before it flows from the compressor to the expansion valve via a condenser, and thus a large temperature gradient is created in the flange. A flange made of plastic material according to the present invention is not affected by such a large temperature gradient across the flange.

In the embodiment shown in Figs. 14 and 15, a single pipe line is used, and in this case a temperature difference also will be created between an operated condition of the air conditioning apparatus and an off condition of the apparatus. Therefore, the flange in the embodiment in Figs. 14 and 15, formed of a plastic resin material, is also not affected by a large temperature gradient.

Furthermore, in the prior art construction of an air conditioning apparatus for an automobile, wherein the flanges are made of a metal material, an excess load is apt to be created in the pipes when made of aluminum. Contrary to this, the flange formed of a plastic material according to the present invention reduces the load applied to the pipes because of a lower weight to volume ratio and a larger strength to weight ratio thereof.

It should be further noted that a plastic material is much harder than steel, and has a hardness value close to that of aluminum. Therefore, the pipes are not damaged by possible contact caused by vibration

generated when the automobile is moving.

In the embodiment as illustrated in Fig. 2, the flange sections 5 and 7 are connected by screws 67, but the engagement of the projected portions 27 and 29 with the hook portions 59 and 61, respectively, makes it possible to eliminate such a screw connection means.

Furthermore, the nuts 21 and 49 in Fig. 2 are not necessarily insert-moulded in the respective flange sections, and separate nuts can be used instead. Furthermore, instead of the nuts 21 and 49, the flange sections 5 and 7 may be provided with respective screw bores with which the bolts 111 are screw engaged.

Although the present invention is described with reference to the attached drawings, many modifications and changes can be made by those skilled in this art without departing from the present invention.

CLAIMS

1. A coupling flange for one or more aluminum refrigerant pipes, the flange having one or more apertures for receiving the pipe(s) and an abutment surface for abutting against a similar surface to form a coupling, the coupling flange being made of nonconductive plastics material at least where it is, in use, in contact with the pipe(s).

2. A flange according to claim 1, wherein the flange comprises a pair of flange sections and means for clamping the pipe(s) between the flange sections.

3. A flange according to claim 2, wherein the clamping means comprises hook-shaped portions of one of the flange sections, the ends of the other flange section being slidably engageable with the hook-shaped portions.

4. A flange according to claim 2 or 3, wherein the clamping means comprises at least one screw and respective pairs of alignable bores in the flange sections which are transverse to the aperture(s), whereby the screw(s) may be used to clamp the flange sections around the pipe(s).

5. A flange according to any one of claims 1 to 4, further comprising a nut moulded into the plastics material of the flange for receiving a bolt to form the coupling.

6. A flange according to any one of claims 1 to 5, wherein each aperture has an annular recess for receiving an annular projection formed at or adjacent to one end of the associated pipe.

7. A flange according to any one of claims 1 to 6, wherein the plastics material of the flange is polypropylene, plyoximethylene, epoxy, polyester or nylon 66.

8. A flange according to any one of claims 1 to 4, wherein the flange is made entirely of the plastics material.

9. A flange according to claim 5, wherein the flange is made entirely of the plastics material except for the embedded nut.

10. A flange according to any one of claims 1 to 9, wherein each aperture opens at one end through the abutment surface.

11. A flange according to any one of claims 1 to 10, wherein the abutment surface is substantially perpendicular to the aperture(s).

12. A flange according to any one of claims 1 to 5, wherein each aperture is arranged to engage the associated pipe to prevent withdrawal of the pipe from the aperture.

13. A pair of flanges each according to any one of claims 1 to 12, the flanges being connected together with their abutment surfaces abutting against each other, thereby to form the coupling.

14. A pair of flanges according to claim 13, wherein each flange is assembled with its respective pipe(s) and an end of each pipe is engaged with an end of a respective pipe of the other flange.

15. A pair of flanges according to claim 13 or 14, wherein the flanges are connected together by nuts and bolts, the bolts extending along bores substantially parallel to the apertures of the flanges and the nuts being moulded into the plastics material of the flanges.

16. A coupling flange for one or more aluminum refrigerant pipes, the flange being substantially as herein described with reference to, or with reference to and as illustrated in, Figures 2 to 15 of the accompanying drawings.

17. All novel features and combinations thereof.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

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Relevant Technical fields

(i) UK Cl (Edition K) F2G G2A G2Z G21A G24E G24Z

(ii) Int CL (Edition 5) F16L 23/032 47/00 47/06 58/18

Search Examiner: R J DOWNING

Databases (see over)

(i) UK Patent Office

(ii)

Date of Search: 1 JUNE 1992

Documents considered relevant following a search in respect of claims 1-16

Category (see over)	Identity of document and relevant passages		Relevant to claim(s)
X	GB 1238230	(MANTON) the whole document especially page 2, lines 25-26	1,6,7, 10-15
X	WO 86/00971 A1	(OHLSSON) the whole document especially page 4, lines 13-17	1,2,4,7, 8,10-14
X	US 4980006	(BORDNER) the whole document	1,7,8, 10-14
&X	US 4900072	(BORDNER) the whole document	1,7,8, 10-14
X	US 3652110	(MANTON) the whole document especially column 1, lines 57-58	1,6,7, 10-14

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

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